MEMORANDUM

To: Mark Pugh and Danielle Johnson, DEQ Date: December 16, 2020

From: Josh Elliott and Erik Naylor, MFA Project No.: 0785.13.01

RE: Final Laboratory Survey Results—Task Order No. 73-18-15-001 Willamette Upriver Reach Background Investigation

Maul Foster & Alongi, Inc. (MFA) prepared this Laboratory Survey Results (LSR) memorandum on behalf of the Oregon Department of Environmental Quality (DEQ) to support the Willamette Upriver Reach Background Investigation. This investigation will be conducted in the Willamette River from river miles 16.6 to 28.4, from approximately the Sellwood Bridge in Portland, Oregon, to the confluence of the Tualatin and Willamette rivers in West Linn, Oregon (Upriver Reach) (Figure 1).

This LSR memo describes the results of the laboratory survey that MFA conducted as detailed in the Laboratory Survey Approach and Methods memorandum issued to DEQ (MFA, 2020). As described in the memorandum, there are four components of the evaluation, which are summarized herein:

- Limit Solicitation and Laboratory Interview
- Data Review
- Validation Review
- Limit Determination

A helpful set of definitions and results is provided below.

DEFINITIONS

Critical to understanding the LSR is consistent use of terminology. Relevant terms are defined below.

- Method detection limit (MDL)—The MDL is defined as the minimum measured concentration of a substance that can be reported with 99 percent confidence that the measured concentration is distinguishable from method blank results (U.S. Environmental Protection Agency [EPA], 2016c). MDLs are required for Clean Water Act methods (Method 1613B) but no longer required for EPA Method SW-846 analyses (Method 8290A); irrespective of requirements, MDL studies are still often conducted by laboratories using SW-846 methods.

- Estimated detection limit (EDL)—The sample- and analyte-specific EDL is a laboratory's estimate of the concentration of a given analyte that would have to be present to produce a signal with a peak height of at least 3 times the background noise signal level (EPA, 2016b).
- Reporting detection limit (RDL)—For the purposes of this memorandum, RDL includes both the MDL and the EDL.
- Practical quantitation limit (PQL)/lower limit of quantitation (LLOQ)—The lowest concentration that can be reliably measured within specified limits of precision, accuracy, representativeness, completeness, and comparability during routine laboratory operating conditions. The PQL is usually the lowest concentration used to calibrate an instrument after being adjusted for sample volume, sample extract volume, extract cleanup, and injection volume. PQLs are often three to ten times the MDL. Under SW-846 Final Update V (EPA, 2020), a PQL may be considered equivalent to the LLOQ except that the LLOQ is the lowest concentration used to calibrate the instrument. Minimum level (ML) is also a term that may be used instead of LLOQ.
- Method reporting limit (MRL)-For the purposes of this memorandum, MRL includes PQL/LLOQ and ML.
- Estimated Maximum Potential Concentration (EMPC)—An EMPC is a value calculated for a reported analyte when the signal-to-noise ratio is at least 2.5:1 for both quantitation ions, but the ion abundance ratio criteria used for analyte confirmation are not met, or when polychlorinated diphenyl ether interference has occurred (EPA, 2016b). An EMPC value represents the maximum possible result of an analyte that could not be positively identified or a result that co-eluted with diphenyl ethers. The inability to positively identify the analyte could be a result of matrix interference, a coeluting compound, or low response.

LIMIT SOLICITATION AND LABORATORY INTERVIEWS

For this evaluation, MFA contacted the following laboratories:

- Vista Analytical Laboratory in El Dorado Hills, California
- Pace Analytical Services' Dioxin Laboratory in Minneapolis, Minnesota
- Eurofins Test America in Knoxville, Tennessee and Sacramento, California
- Bureau Veritas Laboratories in Calgary, Alberta, Canada
- Alpha Analytical in Westborough, Massachusetts
- ALS Global's Laboratory in Houston, Texas
- SGS Axys in Sidney, British Columbia, Canada
- Pacific Rim Laboratories in Surrey, British Columbia, Canada
- Cape Fear Analytical in Wilmington, North Carolina

- Ceres Analytical Laboratory, Inc., in El Dorado Hills, California
- Analytical Resources, Incorporated, in Tukwila, Washington

For each laboratory, MFA requested the following information:

- Available dioxin/furan reporting limits, including EDLs, MDLs, and PQLs/LLOQs. A summary of this information is provided in Table 1.
- Available standard and expedited turnaround times.
- Pricing for dioxin/furan analysis.
- Example level 2 and level 4 data packages.
- Example electronic data deliverables (EDDs).
- Accreditations.

Reporting limits are summarized in Table 1. The remaining information is summarized in Table 2.

MFA also interviewed a dioxin/furan expert from each laboratory to discuss the following:

- A detailed explanation of the specific analytical method for analysis of dioxin/furans
- Laboratory recommendations and procedures associated with achieving the lowest reporting limits possible for this project
- Current analytical limits and deviations from those limits over time
- Common challenges associated with analysis of dioxins/furans, specifically those that affect reporting limits, and any procedures used to overcome challenges (e.g., extract cleanup)
- History of analyzing samples associated with the Portland Harbor Superfund Site

Laboratory interviews provided MFA a chance to discuss the project and qualitatively gauge each laboratory's dioxin/furan capabilities and the level to which the laboratory may engage during the project. A summary of interview discussions is provided in Table 3.

Each laboratory listed above, with the exception of two, responded to MFA's information request (responding laboratories) and was interviewed. The exceptions were Alpha Analytical, which did not respond to MFA's request for information, and Ceres Analytical Laboratory, Inc., which responded but did not attend the scheduled interview. Responding laboratories each confirmed their capability to use analytical methods 1613B or 8290A (with a preference for 1613B for quality control purposes and best reporting limits), meet the requested reporting requirements (including preparation of level 2 and level 4 data packages), and generate EDDs according to the format provided by MFA. In

addition, each of the responding laboratories holds some type of accreditation. Many laboratories are accredited by the Oregon Environmental Laboratory Accreditation Program, while others have accreditation from one or more of the following programs:

- National Environmental Laboratory Accreditation Program (accreditation from states other than Oregon)
- Department of Defense Environmental Laboratory Accreditation Program
- International Organization for Standardization 17025
- Washington State Department of Ecology
- Canadian Association of Laboratory Accreditation

Many laboratories hold all these accreditations. A summary of laboratory accreditations is provided in Table 2.

The pricing information provided by responding laboratories was for typical dioxin/furan analysis only and did not account for additional costs associated with level 4 reporting packages, shipping of samples, and expedited turnaround times. Basic and expedited turnaround times were consistent for all responding laboratories (three to four weeks for standard, one week expedited). The laboratories acknowledge that expedited turnaround time availability depends on laboratory capacity at the time of the project and that the associated price is variable. Prices provided by laboratories during this survey are likely to differ from prices that come from a bid solicitation.

DATA REVIEW

MFA reviewed several recent and available datasets to determine whether the dioxin/furan limits had been achieved in previous analyses of Willamette River sediments. MFA identified five such datasets where sediments had been analyzed for dioxins/furans:

- Remedial Investigation/Feasibility Study (RI/FS) sample data from the Final Portland Harbor RI/FS—Remedial Investigation Report (EPA, 2016a)
- 2017 DEQ Upriver sample date from the Final Field and Data Report—Upriver Reach Sediment Characterization (GSI and Hart Crowser, 2018)
- 2018 Baseline Pre-RD Group from the Pre-Remedial Design Footprint Report (AECOM and Geosyntec, 2019)
- 2018 Baseline EPA Split sampling database
- 2018 DEQ orphan data from the Field and Data Report—Upriver Reach Sediment Investigation (Hart Crowser, 2020)

MFA located dioxin/furan results for 2,015 samples in the identified data sets and compiled the associated results, reporting limits, river miles, collection date, laboratory, validator, qualifiers, and other relevant metadata. The findings of the data review are summarized in Table 4. The data were used to conduct the aspects of the limit determination, as discussed later in this memo. The findings of the data review were also used to inform the validation review, as described below.

VALIDATION REVIEW

MFA reviewed a random selection of available laboratory reports, including those that were referenced in validation reports of interest; validation reports; and validation qualifiers associated with the data sets described in the previous section. These data were evaluated to identify whether limits were elevated, and if so if this resulted from method blank contamination, EMPCs, or other data quality issues that could potentially elevate EDLs, MDLs, and PQLs above the laboratory proposed limits. A summary of the findings for each data set is included in Table 5.

LIMIT DETERMINATION

MFA compared the limits for each dioxin/furan congener provided by responding laboratories against the findings of the data and validation reviews to determine the difference between laboratory proposed limits and limits observed in previously analyzed Willamette River sediment samples. Specifically, MFA compared:

- Limits from each responding laboratory (Table 1)
- Limits from laboratories included in the data and validation review against the limits solicited from the same laboratory (Table 6)
- Limits between and among all laboratories included in the data and validation review (Table 6)
- Variability in limits between congeners (Figures 2 through 4), using 2,3,7,8-TCDD; 2,3,7,8-TCDF; 1,2,3,7,8-PeCDD; 2,3,4,7,8-PeCDF; and 1,2,3,4,7,8-HxCDF as examples.

Laboratory Solicitation Limits

Table 1 provides a summary of the limits provided by responding laboratories. TCDD and TCDF congeners generally have the lowest limits, followed by penta, hepta, and hexa congeners, and lastly octa congeners. The laboratory provided EDLs and MDLs sometimes vary by an order of magnitude between laboratories. Laboratories acknowledged that RDLs have not significantly changed in the past ten years.

EDLs provided by laboratories are based on their theoretical lowest limit (i.e., what they generally report for sediment matrices or averages from the past year of sediment analyses). Therefore, EDLs could be skewed, as some laboratories are likely to see more (or fewer) impacted samples than others. During the interviews, laboratories were confident that their EDLs are realistically achievable but

acknowledged that variability can occur based on sample matrix, moisture content, and presence of interferences.

A comparison of MDLs provides information about how well the laboratories perform in a controlled environment and can be helpful in determining laboratory and analyst proficiency. However, MDLs are not an accurate predictor of the laboratory's ability to handle sediment matrices with high concentrations of dioxins/furans, interferences, or high moisture contents.

The PQLs/LLOQ provided by the laboratories are less likely to be impacted by sample interferences when compared to the EDLs and MDLs, but this could change should less sample volume than the standard extraction volume is extracted. The laboratories would be expected to extract less sample volume in cases where matrix interferences were very high, or dioxin/furan concentrations were above the high end of the calibration. Laboratory PQL/LLOQs ranged significantly, as some laboratories include calibration points below the 1613B method requirements.

Data Review Limits

MFA reviewed the datasets described above and filtered for non-detect results (identified with a U qualifier) to identify all RDLs reported for the datasets. Table 6 summarizes various statistics for RDLs obtained, as well as associated PHSS Record of Decision (ROD) (EPA, 2017) cleanup levels (CULs); principal threat waste (PTW) thresholds; remedial action levels (RAL); and the detection limits solicited from the laboratories. Table 6 also provides the laboratory that generated the data associated with each study (when known) and those limits are compared to the responding laboratories limits. The RDLs from the Upriver Reach and the PHSS were compared for the five dioxin congeners with associated ROD criteria (see Figure 2). The results indicate RDLs tend to be higher in the PHSS which may reflect more matrix interferences in PHSS sediments due to widespread presence of contaminants. Figure 3 shows how RDLs differ between datasets reviewed and that the RDL results are typically below CULs established in the ROD. It is noted that EMPCs were not handled consistently between data sets and EMPCs validated as "J" in one data set and "U" in another data set result in a potential bias when comparing datasets. The elevated RDLs for the 2018 Baseline EPA Split event are likely due to a lower than usual amount of sample volume extracted due to interferences. In addition, MDLs were compiled when sufficient documentation was available. The MDLs reported were equivalent to the RDLs in some cases, and in some cases the MDLs are suspected to be EDLs. In other cases, MDLs were not available. A comparison of RDLs and MDLs for the Upriver Reach is shown in Figure 4. MDLs as well as RDLs for the Upriver Reach are typically below CULs established in the ROD.

CONCLUSIONS

When solicited laboratory limits are compared to dioxin/furan congener-specific PHSS ROD action levels (including PHSS ROD (EPA, 2017) CULs, PTW thresholds, and RALs), the RALs are achievable when compared to laboratory-provided EDLs and MDLs (assuming that matrix interferences do not elevate them significantly) but not when compared to PQLs/LLOQs. There are

exceptions, however, as documented in Table 1. PHSS PTW thresholds are achievable when compared to laboratory EDLs, MDLs, and PQLs/LLOQs.

Congener-specific RDLs reviewed from existing data sets indicate that PTW thresholds have been achieved historically and that CULs and RALs have been achieved much of the time in the reviewed datasets, with the exception of the 2018 Baseline EPA Split event, which had elevated RDLs due to a lower than usual amount of sample volume extracted because of interferences. Many of those data are likely to be J qualified for detections between the EDL or MDL and the PQL/LLOQ or for some other reason that occurred during validation. It should be noted that the qualification method used for EMPCs (U or J) could potentially bias RDLs, depending on the number of EMPC results that were qualified compared to the overall result count.

Some laboratories can meet PHSS CULs and RALs, with some generated data qualified J as estimated between the EDL/MDL and the PQL/LLOQ. Most laboratories can achieve the PHSS PTW threshold, with their PQL/LLOQ resulting in data not qualified J as estimated.

REFERENCES

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TABLES

MAUL FOSTER ALONGI

Table 1
Laboratory Reporting Limits
Upriver Reach Dioxin/Furan Limit Evaluation
Laboratory Survey Results Memorandum

Laboratory:	PH ROD Limits (pg/g)			Pacific Rim Laboratories			SGS Axys			Bureau Veritas Laboratories			Vista Analytical Laboratory			Analytical Resources, Inc.		
Reporting Limit (pg/g):	CUL[1]	PTW[2]	RALs[2]	EDL	MDL	PQL/LLOQ	EDL	MDL	PQL/LLOQ	EDL	MDL	PQL/LLOQ	EDL	MDL	PQL/LLOQ	EDL	MDL	PQL/LLOQ
2,3,7,8-TCDD	0.2	10	0.6	0.043	0.01	0.2	0.05	0.25	0.2	0.111	0.181	0.2	0.20	0.269	0.5	--	0.14	1
1,2,3,7,8-PeCDD	0.2	10	0.8	0.013	0.05	1	0.05	0.53	1	0.105	0.242	1	0.23	0.729	2.5	--	0.18	1
1,2,3,4,7,8-HxCDD	--	--	--	0.008	0.09	1	0.05	0.69	1	0.09	0.211	1	0.30	0.654	2.5	--	0.18	1
1,2,3,6,7,8-HxCDD	--	--	--	0.006	0.1	1	0.05	0.49	1	0.097	0.228	1	0.39	0.593	2.5	--	0.15	1
1,2,3,7,8,9-HxCDD	--	--	--	0.007	0.06	1	0.05	0.6	1	0.094	0.203	1	0.39	0.619	2.5	--	0.22	1
1,2,3,4,6,7,8-HpCDD	--	--	--	0.013	0.09	1	0.05	0.86	1	0.098	0.177	1	0.43	0.615	2.5	--	0.56	2.5
OCDD	--	--	--	0.016	0.2	1	0.05	3.47	2.0	0.146	0.185	1	1.63	1.186	5	--	4.3	10
2,3,7,8-TCDF	0.406	600	--	0.029	0.01	0.2	0.05	0.22	0.2	0.1	0.194	1	0.15	0.168	0.5	--	0.063	1
1,2,3,7,8-PeCDF	--	--	--	0.014	0.07	1	0.05	0.56	1	0.101	0.209	1	0.21	0.729	2.5	--	0.15	1
2,3,4,7,8-PeCDF	0.3	200	200	0.011	0.07	1	0.05	0.55	1	0.099	0.278	2	0.23	0.840	2.5	--	0.15	1
1,2,3,4,7,8-HxCDF	0.4	40	--	0.005	0.09	1	0.05	0.49	1	0.092	0.227	0.2	0.25	0.528	2.5	--	0.14	1
1,2,3,6,7,8-HxCDF	--	--	--	0.006	0.04	1	0.05	0.53	1	0.094	0.258	1	0.26	0.721	2.5	--	0.18	1
1,2,3,7,8,9-HxCDF	--	--	--	0.005	0.08	1	0.05	0.52	1	0.087	0.204	1	0.28	0.707	2.5	--	0.21	1
2,3,4,6,7,8-HxCDF	--	--	--	0.01	0.07	1	0.05	0.53	1	0.111	0.172	1	0.33	0.666	2.5	--	0.11	1
1,2,3,4,6,7,8-HpCDF	--	--	--	0.005	0.05	1	0.05	1.06	1	0.087	0.179	1	0.38	0.678	2.5	--	0.21	1
1,2,3,4,7,8,9-HpCDF	--	--	--	0.006	0.03	1	0.05	0.51	1	0.092	0.244	1	0.32	0.548	2.5	--	0.16	1
OCDF	--	--	--	0.009	0.17	2	0.05	1.18	2.0	0.108	0.743	0.25	0.62	4.507	5	--	1.1	2.5

Table 1
Laboratory Reporting Limits
Upriver Reach Dioxin/Furan Limit Evaluation
Laboratory Survey Results Memorandum

Laboratory:	PH ROD Limits (pg/g)			Cape Fear Analytical			Pace Analytical Services			Eurofins/Test America			ALS Global			Ceres Analytical Laboratory		
Reporting Limit (pg/g):	CUL[1]	PTW[2]	RALs[2]	EDL	MDL	PQL/LLOQ	EDL	MDL	PQL/LLOQ	EDL	MDL	PQL/LLOQ	EDL	MDL	PQL/LLOQ	EDL	MDL	PQL/LLOQ
2,3,7,8-TCDD	0.2	10	0.6	0.121	0.333	1	0.100	0.199	1	--	--	1	0.3	--	1	0.2	0.086	0.5
1,2,3,7,8-PeCDD	0.2	10	0.8	0.0708	1.67	5	0.129	0.258	5	--	--	5	1.5	--	5	1	0.232	2.5
1,2,3,4,7,8-HxCDD	--	--	--	0.107	1.67	5	0.207	0.413	5	--	--	5	1.5	--	5	1	0.547	2.5
1,2,3,6,7,8-HxCDD	--	--	--	0.108	1.67	5	0.234	0.468	5	--	--	5	1.5	--	5	1	0.497	2.5
1,2,3,7,8,9-HxCDD	--	--	--	0.119	1.67	5	0.222	0.443	5	--	--	5	1.5	--	5	1	0.723	2.5
1,2,3,4,6,7,8-HpCDD	--	--	--	0.144	1.67	5	0.270	0.54	5	--	--	5	1.5	--	5	1	0.327	2.5
OCDD	--	--	--	0.253	3.33	10	1.010	2.02	10	--	--	10	3	--	10	5	1.185	5
2,3,7,8-TCDF	0.406	600	--	0.112	0.333	1	0.120	0.239	1	--	--	1	1.5	--	1	0.2	0.105	2.5
1,2,3,7,8-PeCDF	--	--	--	0.0636	1.67	5	0.110	0.219	5	--	--	5	1.5	--	5	1	0.415	2.5
2,3,4,7,8-PeCDF	0.3	200	200	0.0607	1.67	5	0.110	0.219	5	--	--	5	1.5	--	5	1	0.345	2.5
1,2,3,4,7,8-HxCDF	0.4	40	--	0.0637	1.67	5	0.252	0.504	5	--	--	5	1.5	--	5	1	0.281	2.5
1,2,3,6,7,8-HxCDF	--	--	--	0.0657	1.67	5	0.197	0.394	5	--	--	5	1.5	--	5	1	0.311	2.5
1,2,3,7,8,9-HxCDF	--	--	--	0.0692	1.67	5	0.277	0.554	5	--	--	5	1.5	--	5	1	0.5	2.5
2,3,4,6,7,8-HxCDF	--	--	--	0.0977	1.67	5	0.204	0.408	5	--	--	5	1.5	--	5	1	0.483	2.5
1,2,3,4,6,7,8-HpCDF	--	--	--	0.079	1.67	5	0.194	0.388	5	--	--	5	1.5	--	5	1	0.376	2.5
1,2,3,4,7,8,9-HpCDF	--	--	--	0.133	1.67	5	0.257	0.513	5	--	--	5	1.5	--	5	1	0.268	2.5
OCDF	--	--	--	0.251	3.33	10	0.715	1.43	10	--	--	10	3	--	10	5	0.95	5

NOTES:
-- = not available.
CUL = cleanup level—Table 17 of PH ROD.
EDL = estimated detection limit.
HpCDD = heptachlorodibenzo-p-dioxin.
HpCDF = heptachlorodibenzofuran.
HxCDD = hexachlorodibenzo-p-dioxin.
HxCDF = hexachlorodibenzofuran.
LLOQ = lower limit of quantitation.
MDL = method detection limit.
OCDD = octachlorodibenzo-p-dioxin.
OCDF = octachlorodibenzofuran.
pg/g = picograms per gram.
PeCDD = pentachlorodibenzo-p-dioxin.
PeCDF = pentachlorodibenzofuran.
PH ROD = Portland Harbor Record of Decision.
PQL = practical quantitation limit.
PTW = principal threat waste threshold—Table 21 of PH ROD.
RAL = remedial action level—Table 21 of PH ROD.
TCDD = tetrachlorodibenzo-p-dioxin.
TCDF = tetrachlorodibenzofuran.
REFERENCES:
[1]Table 17. Portland Harbor Superfund Site Record of Decision, Portland, Oregon. EPA Region 10. Seattle, Washington, January 2017; EPA. 2020. Errata #2 for Portland Harbor Superfund Site Record of Decision ROD Table 17. January 14.
[2]Table 21. Portland Harbor Superfund Site Record of Decision, Portland, Oregon. EPA Region 10. Seattle, Washington, January 2017.

Table 2
Laboratory Information
Upriver Reach Dioxin/Furan Limit Evaluation
Laboratory Survey Results Memorandum

Laboratory	Methods Available	Standard TAT	Price	Expedited TAT	EDD	Tier 2 Report	Tier 4 Report	Primary Accreditation
Vista Analytical Laboratory	1613B/8290A	3 weeks	$700	1 week	Yes	Yes	Yes	ORELAP/DoD
Pace Analytical Services	1613B/8290/8290A	4 weeks	$525	1 week	Yes	Yes	Yes	ORELAP
Eurofins/Test America	1613B/8290A	4 weeks	$650	1 week	Yes	Yes	Yes	ORELAP/NELAP Florida
Bureau Veritas Laboratories	1613B/8290A	3 weeks	$450	1 week	Yes	Yes	Yes	DoD/NELAP in various states
ALS Global	1613B/8290A	3 weeks	$250	1 week	Yes	Yes	Yes	ORELAP/DoD/ISO 17025
SGS Axys	1613B/8290A	4 weeks	$680	1 week	Yes	Yes	Yes	ISO 17025/CALA/Ecology/NELAP Florida
Pacific Rim Laboratories	1613B	3 weeks	$500	1 week	Yes	Yes	Yes	Ecology/CALA
Cape Fear Analytical	1613B/8290	3 weeks	$435	1 week	Yes	Yes	Yes	Various States/USDA/A2LA
Analytical Resources Inc.	1613B/8290A	3 weeks	$590	1 week	Yes	Yes	Yes	ORELAP/Ecology/DoD
Ceres Analytical Laboratory Inc.	1613B/8290A	2 weeks	$375	1 week	Yes	Yes	Yes	CA ELAP/ORELAP/Ecology
Alpha Analytical	No Response	No Response	No Response	No Response	No Response	No Response	No Response	No Response

NOTES:
CA ELAP = California Environmental Laboratory Accreditation Program.
CALA = Canadian Association of Laboratory Accreditation.
DoD = U.S. Department of Defense.
Ecology = Washington State Department of Ecology.
EDD = electronic data deliverable.
ISO = International Organization for Standardization.
NELAP = National Environmental Laboratory Accreditation Program.
ORELAP = Oregon Environmental Laboratory Accreditation Program.
TAT = turnaround time.
USDA = U.S. Department of Agriculture.

Table 3
Interview Notes
Upriver Reach Dioxin/Furan Limit Evaluation
Laboratory Survey Results Memorandum

Laboratory	Contact	Experience	Date of Interview	Extract Cleanup	Portland Harbor Experience
Vista Analytical Laboratory	Jennifer Christmann, Martha Meir	Over 30 years with a focus on sediment and some of the most contaminated areas of the U.S.	10/23/2020	All method 1613B cleanups are available and used as necessary.	Yes.
Pace Analytical Services	Mary Christie	Over 30 years with many analytes; 20+ years of individual experience.	10/21/2020	All method 1613B cleanups are available and used as necessary.	Yes. Past and ongoing.
Eurofins/Test America	Chris Rigell, Melissa Davidson, Ryan Henry	50+ people, with more than half being there for 20 years.	10/22/2020	All method 1613B cleanups are available and used as necessary.	Not for dioxins/furans but for PCB congeners. Test America Sacramento laboratory did the dioxin/furan analyses.
Bureau Veritas Laboratories	Stephanie Pollen	36 years of experience.	10/26/2020	All method 1613B cleanups are available and used as necessary.	Yes.
ALS Global	Ron Martino, Corey Grandtis, Kristin Neir	Previously CAS lab (around since 2000 at least)—Dx/F lab was an acquisition. Over 10 years as ALS. Five people work in the specialty lab in Houston—lots of collaboration with ALS in Burlington.	10/21/2020	All method 1613B cleanups are available and used as necessary.	Yes.
SGS Axys	Nick Corso, Richard Grace	Thirty-six years with Nick Corso. PMs with over 30 years' experience.	10/23/2020	All method 1613B cleanups are available and used as necessary.	Yes.
Pacific Rim Laboratories	David Hope	Lab is 18 years old—formerly Axys/BV. David d/f since 1988. Fifteen-person lab. Specialized in high-res organics. His business partner developed d/f methods for CA gov.	10/21/2020	All method 1613B cleanups are available and used as necessary.	No.
Cape Fear Analytical	Chris Cornwell	CF has been around for ten years. Partnered with GEL group lab—largest DOE lab in country. They came from a lab that SGS purchased. Most folks have 20+ years. Chris has 40 in lab and 30 in d/f. Small lab—approximately 15 staff.	10/21/2020	All method 1613B cleanups are available and used as necessary.	Yes.
Analytical Resources Inc.	Sue Dunnihoo	Forty years of prep; 36 years' experience at ARI. Organics lab supervisor 36 years.	10/23/2020	All method 1613B cleanups are available and used as necessary.	Possibly ongoing, but the samples would be blinds. In the early 80s ARI did lots of work in PHSS.
Ceres Analytical Laboratory Inc.	James Hedin	No show.	10/22/2020	No show.	No show.
Alpha Analytical	Did not respond	Did not respond.	Did not respond	Did not respond	Did not respond.

Table 4
Data Review
Upriver Reach Dioxin/Furan Limit Evaluation
Laboratory Survey Results Memorandum

Study	Year Sampled	Number of Samples Analyzed	Analytical Method (as reported)	Laboratories Used	How Were EMPCs Qualified?	River Miles	Dataset Reporting Limits	Comments
Remedial Investigation/Feasibility Study background reference area (river mile 15.3 to 28.4)[(a)]	1997-2010	770	1613B	Various	Unknown, possibly both	0.7 to 26.1	RDL	--
2017 DEQ Upriver[(b)]	2017	9	EPA 1613B	ALS Global subbed dioxin/furan to ALS Houston, Texas Laboratory	EMPC = J	18.35 to 25.2	EDL and RDL	EMPCs qualified with "J." Some EMPCs also qualified "U," possibly because of batch method blank detections.
2018 Baseline Pre-RD Group[(c)]	2018-2019	1,210	EPA1613B	Test America, CA	EMPC = J	1.9 to 28.3	MDL and RDL/QL	--
2018 Baseline EPA Split[(d)]	2018	17	HRSM01.2	Cape Fear Analytical	EMPC = J	8.5 to Upriver Reach	MDL and CRQL	All samples collected in PH except for two. One of those two came from the Downtown Reach and one from the Upriver Reach.
2018 DEQ Orphan[(e)]	2019	9	EPA 1613B	ALS Global, Burlington	EMPC = U	16.1 to 19.6	MDL	--

NOTES:

-- = no information.

CRQL = contract-required quantitation limit.

DEQ = Oregon Department of Environmental Quality.

EDL = estimated detection limit.

EMPC = estimated maximum potential concentration.

EPA = U.S. Environmental Protection Agency.

HRSM = high-resolution Superfund method.

J = estimated.

MDL = method detection limit.

QL = quantitation limit.

RDL = reporting detection limit.

U = non-detect.

REFERENCES:

[(a)]Remedial Investigation/Feasibility Study (RI/FS) background reference area (river mile 15.3 to 28.4) sample data from the Final Portland Harbor RI/FS—Remedial Investigation Report (EPA, 2016a).

[(b)]2017 DEQ Upriver sample data from the Final Field and Data Report—Upriver Reach Sediment Characterization (GSI & Hart Crowser, 2018).

[(c)]2018 Baseline Pre-RD Group from the Pre-Remedial Design Footprint Report (AECOM & Geosyntec, 2019).

[(d)]2018 Baseline EPA Split sampling database.

[(e)]2018 DEQ Orphan data from the Field and Data Report—Upriver Reach Sediment Investigation (Hart Crowser, 2020).

	2016 Portland Harbor RI/FS	2017 DEQ Upriver	2018 Baseline Pre-RD Group
Validation Level:	All results in FS database are labeled with QA2Cat1 (1999 data) or QA2Cat2 (all remaining 1997, 1999, 2002-2010).	Not stated, no copy of DVM, but appears to be level II based on description	From QAPP: 10% Stage 4 validation, 90% EPA Stage 2A
Validator:	Integral Consulting, EcoChem (Round 2A, 3B), Laboratory Data Consultants (Round 1)	Hart Crowser	AECOM
Validation Guidance Referenced:	LWG Round 1: EPA. 2002. National Functional Guidelines for Chlorinated Dioxin/Furan Data Review. Final. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC. (August 2002). LWG Round 2A: EPA. 1996. EPA Region 10 SOP for the Validation of Polychlorinated Dibenzodioxin (PCDD) and Polychlorinated Dibenzofuran (PCDF) Data. U.S. Environmental Protection Agency, Region 10, Environmental Services Division, Seattle, WA. EPA. 1999. Laboratory Data Validation: Functional Guidelines for Evaluating Organic Analysis. U.S. Environmental Protection Agency, Hazardous Site Evaluation Division, Washington, DC. EPA. 1999. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review. EPA 540/R-99/00801. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC. October, 1999.	EPA. 1995. EPA Region 10 SOP for the Validation of Method 1668 Toxic, Dioxin-like PCB Data. U.S. Environmental Protection Agency Region 10, Environmental Services Division, Seattle, WA. December 8. EPA. 2002. Guidance on Environmental Data Verification and Data Validation. EPA QA/G-8. EPA/240/R-02/004. November. EPA. 2011. USEPA National Functional Guidelines for Chlorinated Dibenzo-p-Dioxins (CDDs) and Chlorinated Dibenzofurans (CDFs) Data Review. EPA 540-R-11-016. September.	EPA Method 1613B: Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution HRGC/HRMS (October 1994) EPA Contract Laboratory Program National Functional Guidelines for High Resolution Superfund Methods Data Review (April 2016)

	2016 Portland Harbor RI/FS	2017 DEQ Upriver	2018 Baseline Pre-RD Group
General Validation Notes:	FS sediment database is from the RI SCRA database (collected up to 7/19/2010), updates posted via LWG through February 2011, NWN's EE/CA dataset provided in 2013, and Arkema EE/CA datasets provided in 2014. (From RI/FS Appendix A) Per RI data selection rules, the FS database includes data with quality assurance approval code indicating a Category 1 level of data quality and either a level of validation of "QA1" or "QA2." **From 2016 Portland Harbor RI/FS page 2-66:** •Category 1. Category 1 data are of known quality and are considered acceptable for use in decision making for the Site. There is sufficient information on these data sets to confidently verify that the data, along with associated data qualifiers, accurately represent chemical concentrations present at the time of sampling. • Category 2. Category 2 data are of generally unknown or suspect quality. The quality assurance and quality control (QA/QC) information shows that data quality is poor or suspect, or essential QA/QC data (e.g., surrogate recoveries, matrix spike/matrix spike duplicates) are either incomplete or lacking. Based on 2014 RI/FS table 2.3-1, QA1 appears to be similar to Stage 2A and QA2 appears to be similar to Stage 4. However, round 2A document states that 10% of sediment data were "fully validated" and remaining were validated at Level 3 by EcoChem, Inc.	Validation Reports in Appendix E of the May 2018 Hart Crowser Final Field and Data report, but these were not provided to the Portland Harbor data portal.	Validation is based on the March 2018 Pre-RD QAPP. Confirmed that stage 4 and 2A DVRs are both present. Quality Assurance Project Plan, Portland Harbor Pre-Remedial Design Investigation and Baseline Sampling, Portland Harbor Superfund Site (March 2018), and the laboratory quality control (QC) limits
Dioxin/Furan Specific Notes:	The 1999 data designated as Category QA1 is from COE "Willamette April Sediment Quality Evaluation." All remaining dioxin/furan data are designated Category QA2. The LWG Round 2A report states that data were validated with EPA National Functional Guidelines and region 10 SOPs. (EPA 1994, 1995, 1996, 1999). FS database contains several datasets from 1997-2010. Dioxin/furan validation qualification throughout dataset might not be consistent.	The data file provided only a single field of results. Non-detect results (U) are EDLs or detection limits raised based on method blank detections. Some EMPCs were qualified by Hart Crowser as non-detect with "U" but these were associated with method blank detections. Remaining EMPCs were qualified with "J." Non-detect result in the final EDD are indistinguishable from original EDLs. (RDL is the final detection limit which is either the EDL or raised detection limit based on validation).	Results flagged with "q" by Test America as EMPCs were qualified by AECOM with "JN." The final RDL and the MDL (EDL) were both provided in the EDD. Based on reporting/validation the RDL is the MDL/EDL.

	2018 Baseline EPA Split	2019 DEQ Orphan
Validation Level:	EPA Stage IV	Level II Validation
Validator:	EPA Region 10 Environmental Services Unit, OERA	Hart Crowser
Validation Guidance Referenced:	Quality Assurance Project Plan (QAPP) for Portland Harbor Oversight Split Samples, 06/04/2018 EPA Contract Laboratory Program Statement of Work for High Resolution Superfund Methods (Multi-Media, Multi-Concentration) HRSM01.2 EPA National Functional Guidelines for High Resolution Superfund Methods Data Review (EPA542-B-16-001) Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use (EPA-540-R-08-005).	EPA 2002. Guidance on Environmental Data Verification and Data Validation, EPA QA/G-8. November 2002. EPA 2011. USEPA National Functional Guidelines for Chlorinated Dibenzo-p-Dioxins (CDDs) and Chlorinated Dibenzofurans (CDFs) Data Review. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation (OSRTI), Washington, DC. EPA 540-R-11-016. September 2011. EPA 2017. USEPA National Functional Guidelines for Organic Superfund Methods Data Review. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation (OSRTI), Washington, DC. EPA-540-R-2017-002. January 2017.

	2018 Baseline EPA Split	2019 DEQ Orphan
General Validation Notes:	"RMDL - Portland Harbor 47975_PJHSL1 Validation and Review of HRMS Data_04-12-2019" Missing three attachments: manual/electronic data review results, sample summary report, and data validation report - analytical sample listing	Validation reported in Appendix C of "6220-URSI-Field and Data Report_01-31-20"
Dioxin/Furan Specific Notes:	Results with "ion ratios outside criteria" (EMPC) are not additionally qualified. EMPCs were flagged by Cape Fear with * and were reported as detections by EPA. EDL/MDLs appear to be accurate. RDLs represent the original MDLs, as EMPCs were not qualified as nondetect. MDLs represent the original MDLs.	EMPC-flagged 2378-TCDF,12378-PeCDF, 123478-HxCDF, 123678-HxCDF, and OCDF results in method blank were not evaluated against samples because they were considered "not detected" by the reviewer. This could introduce some positive bias for these results. MDL/EDL unaffected. ALS Burlington reported EMPCs as "ion abundance ratio did not meet acceptance criteria" instead of EMPC, which is also an available flag. Hart Crowser qualified all "R" flagged results (ion ratios did not meet positive identification criteria) with "UJ." RDLs represent qualified results, including results qualified based on EMPCs. MDLs represent original laboratory MDLs.

NOTES:
> = greater than.
COE = U.S. Army Corp of Engineers.
DEQ = Oregon Department of Environmental Quality.
DVM = data validation memorandum.
DVR = data validation report.
EDD = electronic data deliverable.
EDL = estimated detection limit.
EE/CA = engineering evaluation/cost analysis.
EMPC = estimated maximum potential concentration.
EPA = U.S. Environmental Protection Agency.
FS = feasibility study.
HxCDF = hexachlorodibenzofuran.
LWG = Lower Willamette River Group.
OCDF = octachlorodibenzofuran.
OERA = Office of Environmental Review and Assessment.
PeCDD = pentachlorodibenzo-p-dioxin.
PeCDF = pentachlorodibenzofuran.
QA = quality assurance.
QA2Cat1 = quality assurance 2 category 1.
QA2Cat2 = quality assurance 2 category 2.
QAPP = quality assurance project plan.
QC = quality control.
RD = remedial design.
RDL = reporting detection limit.
RI = remedial investigation.
SCRA = site characterization and risk assessment.
SOP = standard operating procedure.
TCDF = tetrachlorodibenzofuran.

Table 6
Solicited Reporting Limits vs Study Reporting Limits
Upriver Reach Dioxin/Furan Limit Evaluation
Laboratory Survey Results Memorandum

Laboratory or Study:	PH ROD Limits			Data Review Limits[3]											
				2016 Portland Harbor FS (Various Laboratories)			2017 DEQ Upriver (ALS Houston)			2018 Baseline Pre-RD Group (Test America, West Sacramento)			2018 Baseline EPA Split (Cape Fear Analytical)		
Reporting Limit (pg/g):	CUL[1]	RALs[2]	PTW[2]	GeoMean	50 Percentile	SEM	GeoMean	50 Percentile	SEM	GeoMean	50 Percentile	SEM	GeoMean	50 Percentile	SEM
2,3,7,8-TCDD	0.2	0.6	10	0.032	0.028	0.020	0.277	0.233	0.072	0.083	0.240	0.038	0.519	0.080	0.467
1,2,3,7,8-PeCDD	0.2	0.8	10	0.050	0.042	0.051	0.140	0.133	0.023	0.135	2.300	0.014	4.653	0.130	3.480
1,2,3,4,7,8-HxCDD	--	--	--	0.065	0.050	0.057	0.102	0.106	0.012	0.141	1.800	0.093	3.565	0.130	2.651
1,2,3,6,7,8-HxCDD	--	--	--	0.079	0.059	1.098	0.141	0.141	NA	0.125	1.500	0.142	3.036	0.120	2.255
1,2,3,7,8,9-HxCDD	--	--	--	0.064	0.056	0.069	0.224	0.229	0.026	0.117	2.900	0.142	5.853	0.110	4.361
1,2,3,4,6,7,8-HpCDD	--	--	--	0.755	0.815	0.205	NA	NA	NA	0.668	1.400	0.373	2.791	0.640	2.060
OCDD	--	--	--	4.618	4.600	1.300	--	NA	NA	0.540	3.400	0.171	6.835	0.500	5.084
2,3,7,8-TCDF	0.40658	--	600	0.091	0.120	0.012	0.172	0.137	0.047	0.131	0.360	0.023	0.831	0.130	0.675
1,2,3,7,8-PeCDF	--	--	--	0.044	0.033	61.660	0.135	0.125	0.029	0.160	2.000	0.067	4.687	0.150	14.490
2,3,4,7,8-PeCDF	0.3	200	200	0.035	0.029	0.060	0.185	0.182	0.045	0.171	1.100	0.075	2.493	0.160	7.539
1,2,3,4,7,8-HxCDF	0.4	--	40	0.064	0.045	5.116	0.200	0.244	0.054	0.261	1.900	0.117	3.848	0.240	2.891
1,2,3,6,7,8-HxCDF	--	--	--	0.052	0.035	28.730	0.165	0.144	0.058	0.261	2.300	0.110	4.653	0.230	3.480
1,2,3,7,8,9-HxCDF	--	--	--	0.042	0.037	0.012	0.124	0.129	0.020	0.228	1.800	0.087	3.991	0.200	8.753
2,3,4,6,7,8-HxCDF	--	--	--	0.042	0.034	0.036	0.146	0.155	0.036	0.190	1.200	0.091	2.351	0.170	1.752
1,2,3,4,6,7,8-HpCDF	--	--	--	0.163	0.190	0.118	0.930	1.040	0.308	0.365	2.700	0.100	5.498	0.335	4.100
1,2,3,4,7,8,9-HpCDF	--	--	--	0.069	0.056	0.045	0.118	0.122	0.011	0.433	2.700	0.102	5.483	0.400	4.100
OCDF	--	--	--	0.596	0.622	3.469	--	NA	NA	0.136	2.200	0.021	4.550	0.120	3.374

Table 6
Solicited Reporting Limits vs Study Reporting Limits
Upriver Reach Dioxin/Furan Limit Evaluation
Laboratory Survey Results Memorandum

Laboratory or Study:	PH ROD Limits			Data Review Limits: 2019 DEQ Orphan (ALS Burlington)			Pacific Rim Laboratories			SGS Axys			Bureau Veritas Laboratories			Vista Analytical Laboratory		
Reporting Limit (pg/g):	CUL[1]	RALs[2]	PTW[2]	GeoMean	50 Percentile	SEM	EDL	MDL	PQL/LLOQ	EDL	MDL	PQL/LLOQ	EDL	MDL	PQL/LLOQ	EDL	MDL	PQL/LLOQ
2,3,7,8-TCDD	0.2	0.6	10	0.086	0.070	0.025	0.043	0.01	0.2	0.05	0.25	0.8	0.111	0.181	1	0.20	0.269	0.5
1,2,3,7,8-PeCDD	0.2	0.8	10	0.043	0.039	0.014	0.013	0.05	1	0.05	0.53	2.5	0.105	0.242	5	0.23	0.729	2.5
1,2,3,4,7,8-HxCDD	--	--	--	0.061	0.044	0.023	0.008	0.09	1	0.05	0.69	2.5	0.09	0.211	5	0.30	0.654	2.5
1,2,3,6,7,8-HxCDD	--	--	--	0.055	0.061	0.011	0.006	0.1	1	0.05	0.49	2.5	0.097	0.228	5	0.39	0.593	2.5
1,2,3,7,8,9-HxCDD	--	--	--	0.054	0.043	0.013	0.007	0.06	1	0.05	0.6	2.5	0.094	0.203	5	0.39	0.619	2.5
1,2,3,4,6,7,8-HpCDD	--	--	--	0.063	0.057	0.032	0.013	0.09	1	0.05	0.86	2.5	0.098	0.177	5	0.43	0.615	2.5
OCDD	--	--	--	0.082	0.077	0.046	0.016	0.2	1	0.05	3.47	5.0	0.146	0.185	5	1.63	1.186	5
2,3,7,8-TCDF	0.40658	--	600	0.071	0.059	0.025	0.029	0.01	0.2	0.05	0.22	0.5	0.1	0.194	5	0.15	0.168	0.5
1,2,3,7,8-PeCDF	--	--	--	0.058	0.048	0.025	0.014	0.07	1	0.05	0.56	2.5	0.101	0.209	5	0.21	0.729	2.5
2,3,4,7,8-PeCDF	0.3	200	200	0.054	0.042	0.044	0.011	0.07	1	0.05	0.55	2.5	0.099	0.278	10	0.23	0.840	2.5
1,2,3,4,7,8-HxCDF	0.4	--	40	0.048	0.047	0.020	0.005	0.09	1	0.05	0.49	2.5	0.092	0.227	1	0.25	0.528	2.5
1,2,3,6,7,8-HxCDF	--	--	--	0.047	0.045	0.015	0.006	0.04	1	0.05	0.53	2.5	0.094	0.258	5	0.26	0.721	2.5
1,2,3,7,8,9-HxCDF	--	--	--	0.140	0.130	0.025	0.005	0.08	1	0.05	0.52	2.5	0.087	0.204	5	0.28	0.707	2.5
2,3,4,6,7,8-HxCDF	--	--	--	0.072	0.044	0.127	0.01	0.07	1	0.05	0.53	2.5	0.111	0.172	5	0.33	0.666	2.5
1,2,3,4,6,7,8-HpCDF	--	--	--	0.050	0.032	0.129	0.005	0.05	1	0.05	1.06	2.5	0.087	0.179	5	0.38	0.678	2.5
1,2,3,4,7,8,9-HpCDF	--	--	--	0.050	0.036	0.107	0.006	0.03	1	0.05	0.51	2.5	0.092	0.244	5	0.32	0.548	2.5
OCDF	--	--	--	0.058	0.043	0.023	0.009	0.17	2	0.05	1.18	5.0	0.108	0.743	10	0.62	4.507	5

Laboratory or Study:	PH ROD Limits			Analytical Resources, Inc.			Cape Fear Analytical			Pace Analytical Services			Eurofins/Test America			ALS Global		
Reporting Limit (pg/g):	CUL[1]	RALs[2]	PTW[2]	EDL	MDL	PQL/LLOQ	EDL	MDL	PQL/LLOQ	EDL	MDL	PQL/LLOQ	EDL	MDL	PQL/LLOQ	EDL	MDL	PQL/LLOQ
2,3,7,8-TCDD	0.2	0.6	10	--	0.14	1	0.121	0.333	1	--	0.199	1	--	--	1	0.3	--	1
1,2,3,7,8-PeCDD	0.2	0.8	10	--	0.18	1	0.0708	1.67	5	--	0.258	5	--	--	5	1.5	--	5
1,2,3,4,7,8-HxCDD	--	--	--	--	0.18	1	0.107	1.67	5	--	0.413	5	--	--	5	1.5	--	5
1,2,3,6,7,8-HxCDD	--	--	--	--	0.15	1	0.108	1.67	5	--	0.468	5	--	--	5	1.5	--	5
1,2,3,7,8,9-HxCDD	--	--	--	--	0.22	1	0.119	1.67	5	--	0.443	5	--	--	5	1.5	--	5
1,2,3,4,6,7,8-HpCDD	--	--	--	--	0.56	2.5	0.144	1.67	5	--	0.54	5	--	--	5	1.5	--	5
OCDD	--	--	--	--	4.3	10	0.253	3.33	10	--	2.02	10	--	--	10	3	--	10
2,3,7,8-TCDF	0.40658	--	600	--	0.063	1	0.112	0.333	1	--	0.239	1	--	--	1	1.5	--	1
1,2,3,7,8-PeCDF	--	--	--	--	0.15	1	0.0636	1.67	5	--	0.219	5	--	--	5	1.5	--	5
2,3,4,7,8-PeCDF	0.3	200	200	--	0.15	1	0.0607	1.67	5	--	0.219	5	--	--	5	1.5	--	5
1,2,3,4,7,8-HxCDF	0.4	--	40	--	0.14	1	0.0637	1.67	5	--	0.504	5	--	--	5	1.5	--	5
1,2,3,6,7,8-HxCDF	--	--	--	--	0.18	1	0.0657	1.67	5	--	0.394	5	--	--	5	1.5	--	5
1,2,3,7,8,9-HxCDF	--	--	--	--	0.21	1	0.0692	1.67	5	--	0.554	5	--	--	5	1.5	--	5
2,3,4,6,7,8-HxCDF	--	--	--	--	0.11	1	0.0977	1.67	5	--	0.408	5	--	--	5	1.5	--	5
1,2,3,4,6,7,8-HpCDF	--	--	--	--	0.21	1	0.079	1.67	5	--	0.388	5	--	--	5	1.5	--	5
1,2,3,4,7,8,9-HpCDF	--	--	--	--	0.16	1	0.133	1.67	5	--	0.513	5	--	--	5	1.5	--	5
OCDF	--	--	--	--	1.1	2.5	0.251	3.33	10	--	1.43	10	--	--	10	3	--	10

Laboratory or Study:	PH ROD Limits			Ceres Analytical Laboratory			Alpha Analytical		
Reporting Limit (pg/g):	CUL[1]	RALs[2]	PTW[2]	EDL	MDL	PQL/LLOQ	EDL	MDL	PQL/LLOQ
2,3,7,8-TCDD	0.2	0.6	10	0.2	0.086	0.5	NA	NA	NA
1,2,3,7,8-PeCDD	0.2	0.8	10	1	0.232	2.5	NA	NA	NA
1,2,3,4,7,8-HxCDD	--	--	--	1	0.547	2.5	NA	NA	NA
1,2,3,6,7,8-HxCDD	--	--	--	1	0.497	2.5	NA	NA	NA
1,2,3,7,8,9-HxCDD	--	--	--	1	0.723	2.5	NA	NA	NA
1,2,3,4,6,7,8-HpCDD	--	--	--	1	0.327	2.5	NA	NA	NA
OCDD	--	--	--	5	1.185	5	NA	NA	NA
2,3,7,8-TCDF	0.40658	--	600	0.2	0.105	2.5	NA	NA	NA
1,2,3,7,8-PeCDF	--	--	--	1	0.415	2.5	NA	NA	NA
2,3,4,7,8-PeCDF	0.3	200	200	1	0.345	2.5	NA	NA	NA
1,2,3,4,7,8-HxCDF	0.4	--	40	1	0.281	2.5	NA	NA	NA
1,2,3,6,7,8-HxCDF	--	--	--	1	0.311	2.5	NA	NA	NA
1,2,3,7,8,9-HxCDF	--	--	--	1	0.5	2.5	NA	NA	NA
2,3,4,6,7,8-HxCDF	--	--	--	1	0.483	2.5	NA	NA	NA
1,2,3,4,6,7,8-HpCDF	--	--	--	1	0.376	2.5	NA	NA	NA
1,2,3,4,7,8,9-HpCDF	--	--	--	1	0.268	2.5	NA	NA	NA
OCDF	--	--	--	5	0.95	5	NA	NA	NA

NOTES:
-- = no data available.
CUL = cleanup level.
DEQ = Oregon Department of Environmental Quality.
EDL = estimated detection limit.
EPA = U.S. Environmental Protection Agency.
FS = feasibility study.
GeoMean = geometric mean.
HpCDD = heptachlorodibenzo-p-dioxin.
HpCDF = heptachlorodibenzofuran.
HxCDD = hexachlorodibenzo-p-dioxin.
HxCDF = hexachlorodibenzofuran.
LLOQ = lower limit of quantitation.
MDL = method detection limit.
NA = not applicable.
OCDD = octachlorodibenzo-p-dioxin.
OCDF = octachlorodibenzofuran.
PeCDD = pentachlorodibenzo-p-dioxin.
PeCDF = pentachlorodibenzofuran.
pg/g = picograms per gram.
PH ROD = Portland Harbor Superfund Site Record of Decision.
PQL = practical quantitation limit.
PTW = principal threat waste threshold.
RAL = remedial action level.
RAO = remedial action objective.
SEM = standard error of the mean.
TCDD = tetrachlorodibenzo-p-dioxin.
TCDF = tetrachlorodibenzofuran.
REFERENCES:
[1]Table 17. Portland Harbor Superfund Site Record of Decision, Portland, Oregon. EPA Region 10. Seattle, Washington, January 2017; EPA. 2020. Errata #2 for Portland Harbor Superfund Site Record of Decision ROD Table 17. January 14.
[2]Table 21. Portland Harbor Superfund Site Record of Decision, Portland, Oregon. EPA Region 10. Seattle, Washington, January 2017.
[3]See Dataset Reporting Limit column of Table 4 for specific limit type.

FIGURES

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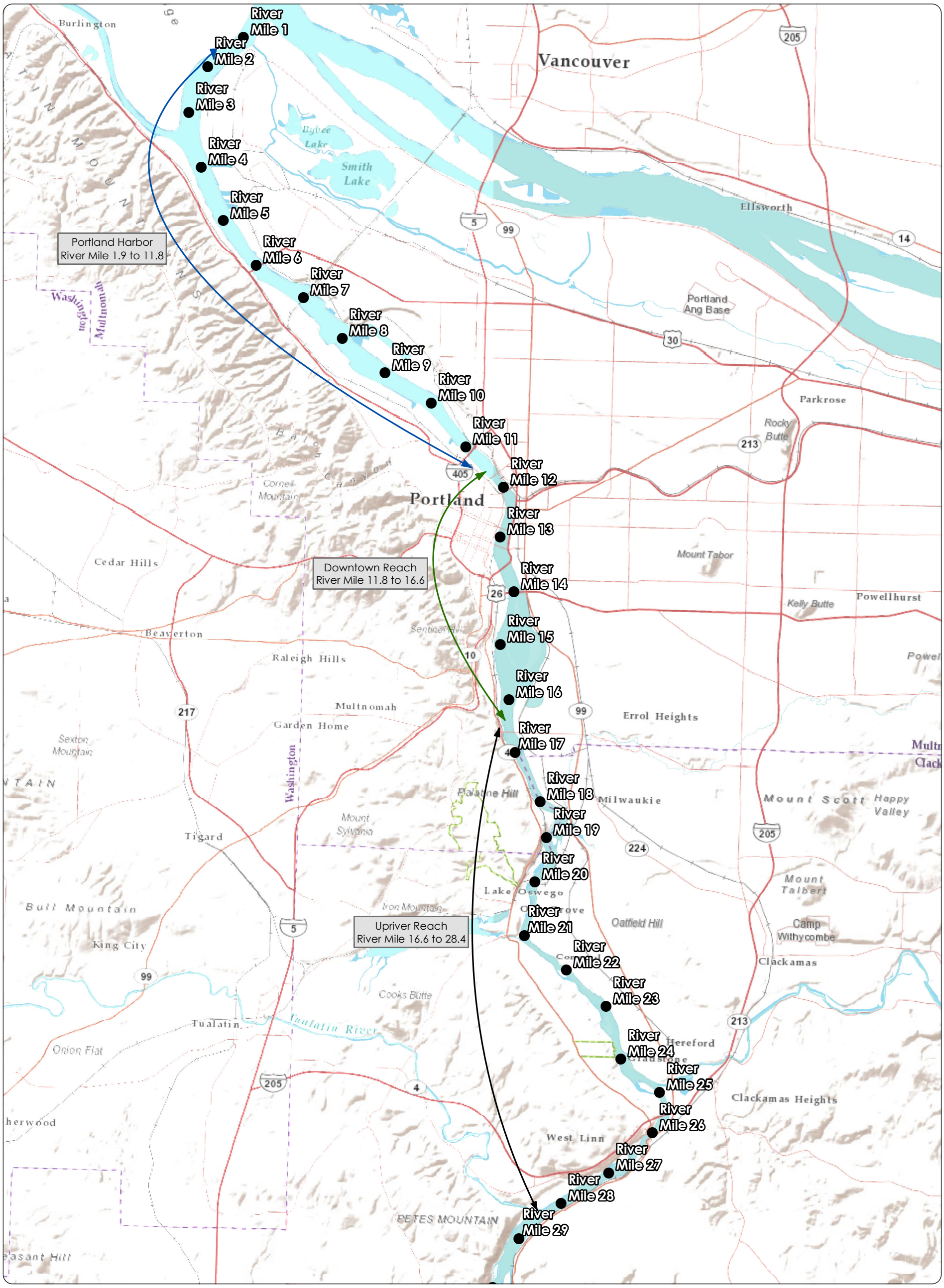

Legend

- River Mile Marker

Figure 1
Willamette Upriver Reach Background Investigation
DEQ
Portland, Oregon

Source:
Basemap obtained from ArcGIS Online.

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0 4,500 9,000
Feet

Project:
Produced By: jelliott
Approved By:
Print Date: 9/23/2020

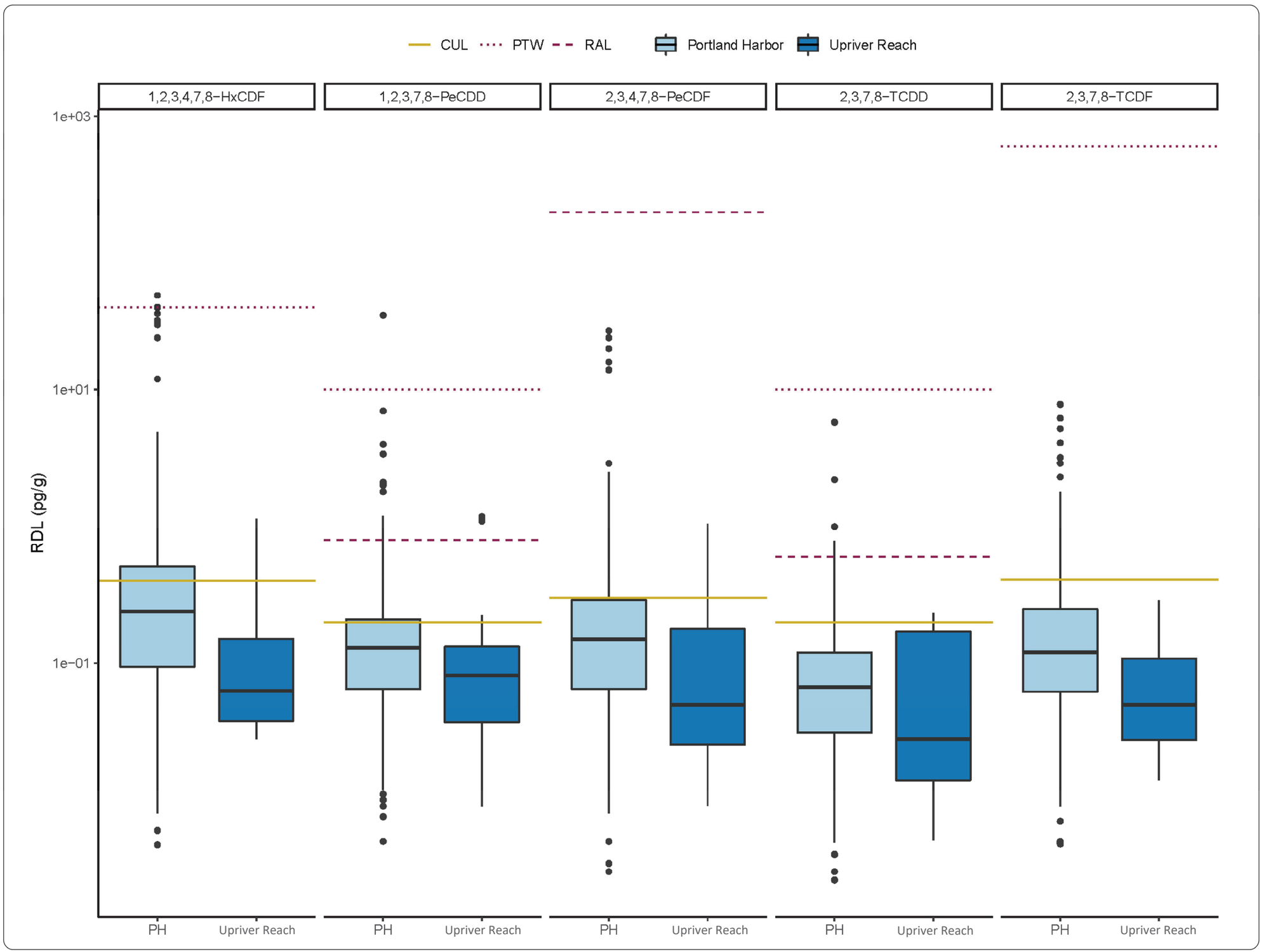

Figure 2
Area RDL

Laboratory Survey Results
–Task Order No. 73-18-15-001
Willamette Upriver Reach
Background Investigation

NOTES:
CUL = cleanup level - Table 17 of PH Record of Decision.
HxCDF = hexachlorodibenzofuran
MDL = method detection limit
PeCDD = pentachlorodibenzo-p-dioxin
PeCDF = pentachlorodibenzofuran
pg/g = picograms per gram
PH = Portland Harbor
PTW = principal threat waste threshold - Table 21 of PH Record of Decision.
RAL = remedial action level - Table 21 of PH Record of Decision
RDL = reporting detection limit
TCDD = tetrachlorodibenzo-p-dioxin
TCDF = tetrachlorodibenzofuran

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Figure 3
Source RDL

Laboratory Survey Results
–Task Order No. 73-18-15-001
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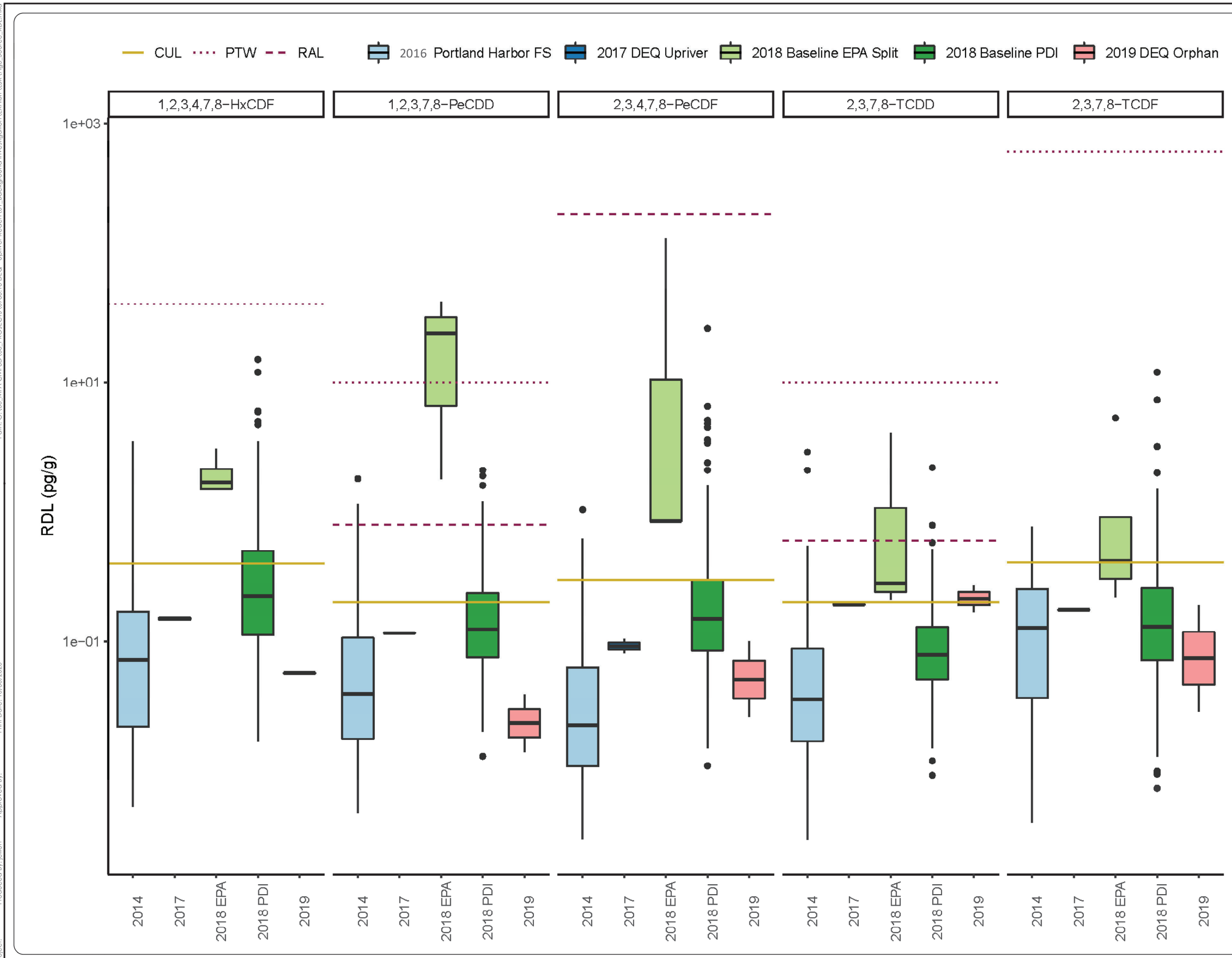
Background Investigation



NOTES:
CUL = cleanup level - Table 17 of PH Record of Decision.
FS = feasibility study
HxCDF = hexachlorodibenzofuran
MDL = method detection limit
PDI = pre-design investigation
PeCDD = pentachlorodibenzo-p-dioxin
PeCDF = pentachlorodibenzofuran
pg/g = picograms per gram
PH = Portland Harbor
PTW = principal threat waste threshold - Table 21 of PH Record of Decision.
RAL = remedial action level - Table 21 of PH Record of Decision
RDL = reporting detection limit
TCDD = tetrachlorodibenzo-p-dioxin
TCDF = tetrachlorodibenzofuran
Upriver = Upriver Reach of the Willamette River

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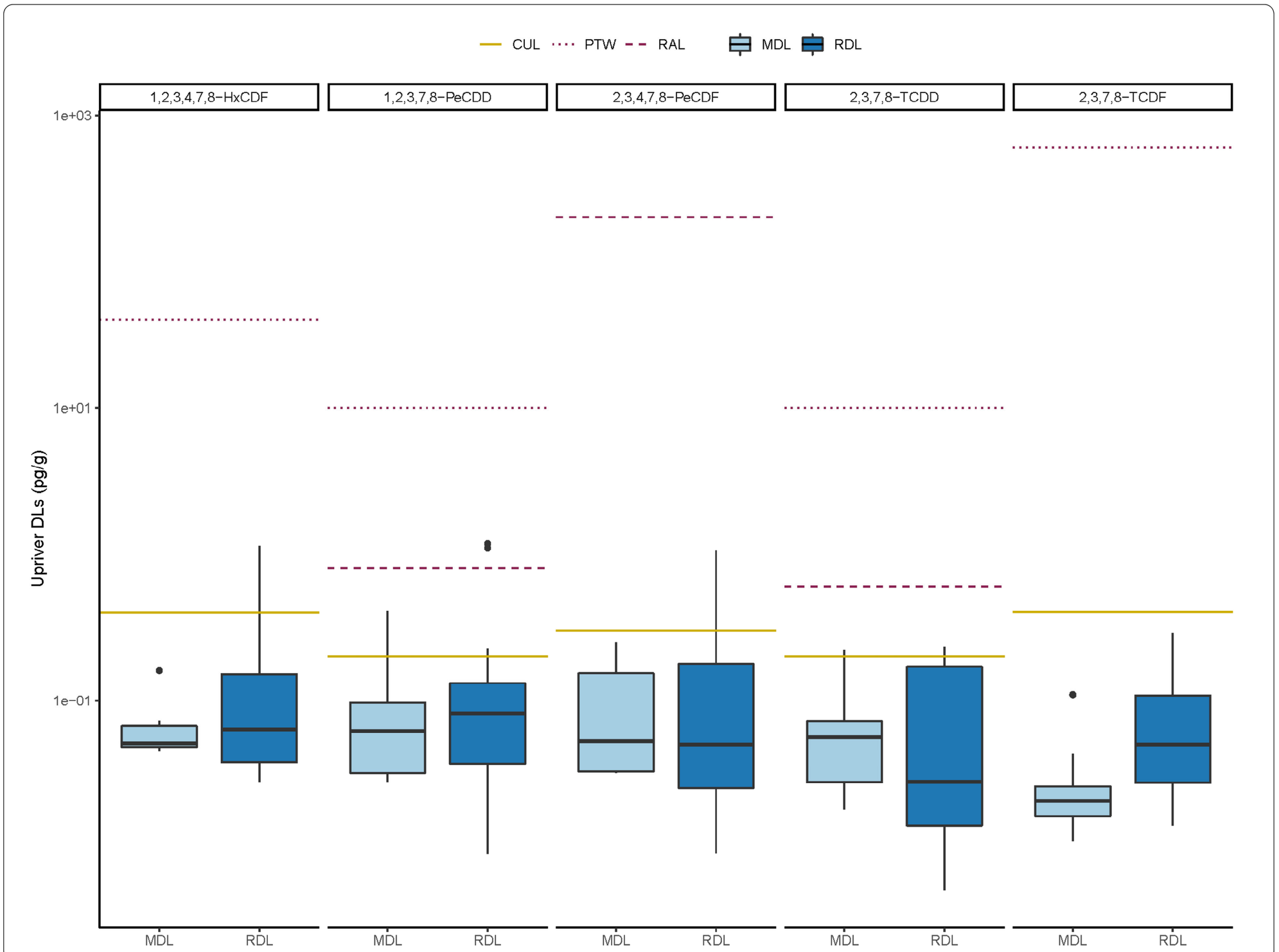

Figure 4
Upriver RDL vs MDL
Laboratory Survey Results
–Task Order No. 73-18-15-001
Willamette Upriver Reach
Background Investigation

NOTES:
CUL = cleanup level - Table 17 of PH Record of Decision.
DL = detection limit
HxCDF = hexachlorodibenzofuran
MDL = method detection limit
PeCDD = pentachlorodibenzo-p-dioxin
PeCDF = pentachlorodibenzofuran
pg/g = picograms per gram
PH = Portland Harbor
PTW = principal threat waste threshold - Table 21 of PH Record of Decision.
RAL = remedial action level - Table 21 of PH Record of Decision
RDL = reporting detection limit
TCDD = tetrachlorodibenzo-p-dioxin
TCDF = tetrachlorodibenzofuran
Upriver = Upriver Reach of the Willamette River

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